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(54) **Method of controlling power on forward link in a cellular CDMA system**

Verfahren zum Steuern der Leistung auf einer Abwärtsstrecke in einem zellularen CDMA-System

Procédé de commande de la puissance de la liaison vers l'avant dans un système cellulaire AMDC

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Description

[0001] The present invention relates generally to techniques in transmission power control of base stations in a CDMA (code division multiple access) cellular system using spread spectrum techniques. More specifically, the present invention relates to a power control method on forward links (viz., base station to mobile unit links) in a CDMA cellular system in order to increase capacity of the overall system.

[0002] As is well known in the art, in a CDMA system, all users transmit simultaneously and at the same frequency. The transmitted signals occupy the entire system bandwidth, and code sequences, which are orthogonal, are used to separate one user from another. That is, each user is assigned a unique code sequence. The use of the same frequency in the overall system indicates that no "handoff" from one frequency to another is needed as in FDMA (frequency division multiple access) and TDMA (time division multiple access) systems. This is called a soft handoff that is disclosed in US-A-5,101,501 by way of example.

[0003] In a CDMA system, there is no distinct limit on the number of users. The system performance for all users degrades gradually as the number of active users increases. More specifically, mobile units in the CDMA system transmit independently (viz., asynchronously) from each other. This means that their signals arrive randomly at the base station and therefore, the crosscorrelation between these randomly arrived signals is not zero and thus causes interference.

[0004] The major difficulty with CDMA is a so-called "near-far effect", which occurs when a weak signal received at the base station from a distant mobile unit is overpowered by a strong signal from a nearby interferer. To reduce the near-far effect, power control on reverse links (viz., mobile unit to base station links) is necessary.

[0005] Additionally, the system capacity is expanded by power control on the forward links (viz., base station to mobile unit links). One example of such power control on the forward link is disclosed in JP-A-7-38496. According to this conventional technique, each of the mobile units in a given cell receives a pilot signal from the cell's base station, measures a signal-to-noise (S/N) ratio using the pilot signal received, and then informs the base station of the measurement results. The base station responds to the measurement results and controls the transmission power on the forward link of each mobile unit. Thus, the S/N ratios at the mobile units within the cell are improved and approach a predetermined level (viz, roughly equalized). As a result, a low level of interference is achieved at each mobile unit.

[0006] This conventional technique, however, has suffered from a drawback. That is, when a S/N ratio at a given mobile unit is lowered due to increase in the number of the active users in the cell, the base station is responsive to the reduced S/N ratio and raises the power on the forward link to the given mobile unit. This

in turn undesirably lowers the S/N ratio at each of other mobile units, with the result that the S/N ratio of the first base station again is lowered. This cycle is repeated and eventually the power of each forward link of many mobile units undesirably is raised to the maximum value.

[0007] Further, it takes a relatively long time until the lowering of interference is carried out after the measurement of the S/N ratio. Therefore, during the long feedback time, the S/N ratio measured has undesirably changed. In such a case, a precise control is no longer expected.

[0008] The article "Tuning the macrodiversity performance in a DS-CDMA system" by T. Andersson, 1994 IEEE Vehicular Technology Conference, 8 June 1994, pages 41-45, discloses pilot strength measurements at a mobile unit of all base stations connected to said mobile station (active set). The transmitted signal power of the base stations in the active set is then adjusted using the obtained measurements.

[0009] It is therefore an object of the present invention to provide a method of achieving a low level of interference, especially in the vicinity of a cell boundary, even if the number of active users increases, whereby it is possible to keep constant the system performance for all users. This object is achieved with the features of the claims.

[0010] One aspect of the present invention resides in a method of controlling transmission power of a plurality of base stations associated with a mobile unit in a CDMA (code division multiple access) cellular system, the mobile unit communicating with one base station among the plurality of base stations, the method comprising the steps of: (a) measuring, at the mobile unit, power of each of pilot signals respectively transmitted from the plurality of base stations; (b) advising the one base station of information about a measured power value of each of the pilot signals; (c) determining, at the one base station, a first power control coefficient which is a ratio of total pilot signal power values of the plurality of base stations, other than said one base station, to a pilot signal power value of the one base station; and (d) controlling the transmission power of each of the plurality of base stations using the first power control coefficient.

[0011] The features and advantages of the present invention will become more clearly appreciated from the following description taken in conjunction with the accompanying drawings in which like elements are denoted by like reference numerals and in which:

Fig. 1 is a sketch schematically showing a plurality of cells, base stations, etc. provided in a CDMA cellular system;

Fig. 2 is a time slot format of one frame for acquiring pilot signal power on forward links of base stations; Figs. 3, 4A and 4B are each flow chart which shows steps which characterize a first embodiment of the present invention;

Figs. 5A and 5B are each flow chart which shows

steps which characterize a second embodiment of the present invention;

Fig. 6 is a flow chart which shows steps which characterize a third embodiment of the present invention;

Figs. 7A, 7B and 8 are each flow chart which shows steps which characterize a fourth embodiment of the present invention; and

Figs. 9A and 9B are each flow chart which shows steps which characterize a fifth embodiment of the present invention.

[0012] Referring to Fig. 1, there are shown only three cells 10, 12, and 14 which respectively include base stations BS1, BS2, and BS3. Further, as shown, another three base stations BS4-BS6 are respectively assigned to the other three cells (not shown). As is well known in the art, all the base stations in the system, including BS1-BS6, are coupled to a MTSO (mobile telephone switching office) 16, which supervises the overall operation of the system and which is in turn coupled to a public switched telephone network. Still further, two mobile units 18 and 20 are shown in Fig. 1. The mobile unit 18 is located in the vicinity of the boundary between the cells 10 and 12 and simultaneously communicates with two base stations BS1 and BS2 in order to attain the above mentioned soft handoff. However, it is to be noted that the mobile unit 18 in fact establishes a speech channel with either BS1 or BS2. It is assumed that the other mobile unit 20 is not located in the vicinity of a cell boundary and thus keeps communication only with the base station BS1.

[0013] The present invention is not directly concerned with a handoff operation but directed to effectively achieve a low level of interference in the vicinity of a cell boundary. Therefore, the system capacity can markedly be increased (viz., the number of active users can be increased without inducing degradation of signal quality).

[0014] Each of the base stations in the system constantly transmits a pilot signal the transmission power of which may vary depending on the cell size. However, in the instant disclosure, it is assumed that each base station radiates the corresponding pilot signal with a predetermined (constant) power for the sake of simplifying the description. Each pilot signal is assigned a unique code and thus, it is possible for the mobile unit to discriminate which base station generates the pilot signal.

[0015] On the other hand, each mobile unit is provided with a device for measuring the strength of each of the pilot signals arriving at the mobile unit. More specifically, the mobile unit selectively acquires a predetermined number of pilot signals using codes which are applied thereto from a currently communicating base station.

[0016] Fig. 2 is a diagram showing a pilot signal acquiring (or measuring) frame which consists of six time slots 1-6 in this instance. Each mobile unit acquires one pilot signal during one time slot and thus, is able to cy-

clically receive a total of six different pilot signals on a frame-by-frame basis in this particular case. The mobile unit typically measures the power (viz., signal strength) of one pilot signal during one time slot. If more than six pilot signals should be received at the mobile unit, the frame length can be expanded to meet the requirement. The instantaneous power of the pilot signal typically varies drastically and thus, it is a current practice to average the power over a sufficiently long time. Throughout the instant disclosure, the power of a pilot signal means an average value.

[0017] It is assumed that a mobile unit has already established a speech channel with a given base station (sometimes referred to as a current base station). In this case, the mobile unit receives, from the current base station, information indicating a set of neighboring base stations. Based on this information, the mobile unit measures the power of each of the pilot signals transmitted from the neighboring base stations in addition to the power of the pilot signal from the current base station.

[0018] A first embodiment of the present invention will be described with reference to Figs. 3, 4A and 4B.

[0019] In Fig. 3, at step 22, the mobile unit checks to determine if the current base station should be changed (viz., handoff). The instruction of changing the current base station (denoted by BS_0) is advised from the current base station itself. If the current base station should be changed, the routine goes to step 24 whereat a new base station is advised together with a new set of neighboring base stations BS_i ($i=1, 2, \dots, n$) (n is five in the case shown in Fig. 1 for example). On the other hand, if the answer is negative at step 22, the routine proceeds to step 26. At this step 26, the power of each of the pilot signals on the forward link (viz., inbound link or base station to mobile unit link) in connection with the base stations BS_0 and BS_i are measured. Following this, at step 28, each of the measured pilot signal's power values is compared with a predetermined value (T_1) so as to select the values exceeding T_1 . The power values thus selected are denoted by B_0 and B_i ($i=1, 2, \dots, m$) ($m \leq n$) wherein B_0 is the power value of BS_0 and B_i are power values of BS_i . Thereafter, at step 30, the power values B_0 and B_i are transmitted to the current base station BS_0 .

[0020] Figs. 4A and 4B show steps which are implemented at the current base station. At step 32, the base station receives the power values B_0 and B_i from the mobile unit. Thereafter, at steps 34 and 36, a check is made to determine if the current base station should be changed based on the power values B_0 and B_i received at step 32. If a change of the base station is to be implemented, the data indicating the new base station (denoted by BS'_0) is stored in the current base station. If a change of the current base station is not required, the routine directly goes to step 38 at which a handoff indicator G_h is calculated as follows. In this case, B_i are rewritten by Q_i

$$Gh = (Q_1 + Q_2 + \dots + Q_m) / B_0 \quad (1)$$

Following this, at step 40, the power values B_0 and Q_i , exceeding a second predetermined value (T_2), are selected. The selected power values are denoted by B_0 and Q_i ($i=1, 2, \dots, k$ ($k \leq m$)). It is to be noted that the value B_0 is selected in that this value is the largest one. Following this, a power control coefficient R is calculated as follows at step 42.

$$R = (Q_1 + Q_2 + \dots + Q_k) / Gh - B_0 \quad (2)$$

Therefore, since R can be rewritten using equation (1) as follows.

$$R = (Q_1 + Q_2 + \dots + Q_k) / (Q_1 + Q_2 + \dots + Q_m) \quad (3)$$

[0021] Thereafter, the routine goes to the steps of Fig. 4B wherein if the current base station should not be changed (determined at step 43a) the routine goes through steps 43b and 44 to step 32 (Fig. 4A). On the other hand, if the current station should be changed, the routine goes through steps 46, 48 and 50 and is terminated.

[0022] More specifically, as shown in Fig. 4B, at step 43b, the base station advises the MTSO of the power control coefficient R , and at step 44, the base station changes the transmission power thereof to $R \cdot P_0$ (P_0 is a reference transmission power). On the other hand, if an answer is positive at step 43a, the routine goes to step 46 at which the base station advises the MTSO of the new station. Thereafter, at step 48, the base station receives a new set of neighboring base stations associated with the new base station. Subsequently, at step 50, the base station advises the mobile unit of the new base station and the new neighboring base stations.

[0023] A second embodiment of the present invention will be described with reference to Figs. 5A and 5B.

[0024] As shown in Fig. 5A, steps 32' to 40' are identical to step 32 to 40 and hence further descriptions thereof are omitted for brevity. The second embodiment features that the power control coefficient R is derived using total transmission power values (P_i) of the base stations and the corresponding power values Q_i . In Fig. 5A, P_{max} indicates the maximum allowable power value of each base station. More specifically, at step 52, the base station receives, from the MTSO, a total transmission power value of each of the base stations associated with Q_i (the total transmission power values is denoted by P_i). Thereafter, the routine goes to step 54 whereat the power control coefficient R is calculated as follows: $R = (P_1 Q_1 + P_2 Q_2 + \dots + P_k Q_k) / (Gh \cdot P_{max} \cdot B_0)$. On the other hand, the power control coefficient R should be in a range between previously determined minimum

and maximum values (R_{min} and R_{max}). The manner of defining the coefficient R between R_{min} and R_{max} is shown in Fig. 5B. As shown in Fig. 5B, at step 56, a check is made to determine if $R > R_{max}$. If the answer at step 56 is affirmative, the routine goes to step 58 whereat R is replaced with R_{max} , after which the routine proceeds to the flow chart of Fig. 4B. On the contrary, if the answer at step 56 is negative, the routine goes to step 60 whereat a further check is made to determine if $R < R_{min}$. If the answer at step 60 is affirmative, the routine goes to step 62 whereat R is replaced with R_{min} , after which the routine proceeds to the flow chart of Fig. 4B. On the contrary, if the answer at step 60 is negative, the routine directly goes to the flow chart of Fig. 4B. After implementing either step 62 or step 58, the routine goes to the program which is exactly identical to that shown in Fig. 4B.

[0025] A third embodiment of the present invention will be described with reference to Fig. 6.

[0026] As shown in Fig. 6, steps 32' to 38' are identical to step 32 to 38 and hence further descriptions thereof are omitted for brevity. The third embodiment features that the number of pilot signals (m in this case) is checked for whether or not the number exceeds the previously determined maximum number of pilot signals (N_{max}). If $m > N_{max}$, at step 70, steps 72 and 74 are implemented and the routine proceeds to step 76. Otherwise, the routine implements steps 78 and 80 and then goes to step 76. After carrying out step 76, the routine goes to the program which is exactly identical to that shown in Fig. 4B.

[0027] A fourth embodiment of the present invention will be described with reference to Figs. 7A, 7B and 8. This embodiment is to carry out, at the mobile unit, the steps which are executed in the current base station in the first embodiment. Therefore, the burden on the base station can be reduced.

[0028] As shown in Fig. 7A, steps 22' to 26' are identical to steps 22 to 26 of Fig. 3, while as shown in Fig. 7B, steps 34' to 42' are identical to steps 34 to 42 shown in Fig. 4A. At step 90 (Fig. 7B), if the current base station should be changed, data indicating the new base station (depicted by BS_0') is informed to the current base station together with the power control coefficient R . Otherwise, only the coefficient R is transmitted to the current base station BS_0 . After step 90, the routine returns to step 22' of Fig. 7A in order to repeat the operations. On the other hand, as shown in Fig. 8, at step 92, the current base station receives the information (viz., BS_0' (if any) and R) which the mobile unit transmitted at step 90. Following this, steps 40' to 50' are implemented which are respectively identical to steps 40 to 50 of Fig. 4B.

[0029] A fifth embodiment of the present invention will be described with reference to Figs. 9A and 9B. The instant embodiment features a calculated power control coefficient (denoted by R' in step 42') is checked to determine if R' is within a predetermined range where the current base station should not be changed. For this pur-

pose, the power control coefficient R is initialized at step 100 (viz., R is set to one (1)). The following steps 22' to 40' are exactly identical to steps 22 to 40 shown in Figs. 7A and 7B. At step 42' of Fig 9B is similar to the counterpart of Fig 7B. At step 102, a check is made to determine if the current base station should be changed. If the answer is negative at this step, the routine goes to step 104 at which the calculated power control coefficient R' is checked if R' is within the predetermined range as mentioned above. If the answer at step 104 is NO, the calculated coefficient R' is adopted and then advised to the base station BS₀ at steps 106 and 108. On the other hand, if the answer at step 104 is YES, the routine proceeds to step 22' of Fig. 9A.

[0030] It will be understood that the above disclosure is representative of five possible embodiments of the present invention and that the concept on which the invention is based is not specifically limited thereto.

Claims

1. A method of controlling transmission power of at least one base station among a plurality of base stations associated with a mobile unit in a code division multiple access, CDMA, cellular system, said mobile unit communicating with said at least one base station, said method comprising the steps of:

(a) measuring, at said mobile unit, a power value of each of a plurality of pilot signals respectively transmitted from said plurality of base stations;

(b) determining a first power control coefficient which is a ratio of total pilot power values of said plurality of base stations, other than said at least one base station, to a pilot power value of said at least one base station; and

(c) controlling the transmission power of said at least one base station by using said first power control coefficient.

2. A method as claimed in claim 1, wherein the power value of each of the pilot signals is compared, at said mobile unit, with a predetermined value after step (a), a power exceeding the predetermined value being selected, and the values of selected power being sent to said at least one base station and being used to determine said first power control coefficient in step (b), said first power control coefficient being used to control the transmission power in step (c).

3. A method as claimed in claim 1, wherein the power value of each of the pilot signals is compared, at said mobile unit, with a first predetermined value after step (a), a power exceeding the first predetermined value being selected, and the values of se-

lected power being sent to said at least one base station.

4. A method as claimed in claim 3, wherein each of the values of selected power is compared, at said at least one base station, with a second predetermined value in step (c), and the power values each exceeding said second predetermined value being used to determine said first power control coefficient.

5. A method as claimed in claim 1, 2, 3 or 4, further comprising the steps of:

receiving, at said at least one base station, total transmission power of each of said plurality of base stations from a mobile telephone switching office, MTSO, which is provided in said CDMA cellular system to supervise overall operations of the system;

determining, at said at least one base station, a second power control coefficient which is a ratio of $(P_1Q_1 + P_2Q_2 + \dots + P_kQ_k)$ to $(G_h \cdot P_m \cdot B_0)$ where P_i ($i=1, 2, \dots k$) is the total transmission power of an i -th base station, Q_i ($i=1, 2, \dots k$) is the power value of the pilot signal of an i -th base station other than said at least one base station, P_m is a maximum transmission power of each of the base stations, and B_0 is the power value of the pilot signal of said at least one base station; and

controlling the transmission power of said at least one base station using said second power control coefficient instead of said first power control coefficient.

6. A method of controlling transmission power of at least one base station of a plurality of base stations associated with a mobile unit in a CDMA cellular system, said mobile unit communicating with said at least one base station, said method comprising the steps of:

(a) measuring, at said mobile unit, a first power value of a pilot signal transmitted from said at least one base station and a plurality of second power values each transmitted from said plurality of base stations other than said at least one base station;

(b) advising said at least one base station of said first and second power values;

(c) determining, at said at least one base station, a power control coefficient using said first and second power values; and

(d) controlling the transmission power of said at least one base station using said power control coefficient.

7. A method as claimed in claim 6, wherein each of said first and second values is compared, at said mobile unit, with a first predetermined value after step (a), the power value exceeding said first predetermined value being selected and being sent to said at least one base station.
8. A method as claimed in claim 6 or 7, wherein each of said first and second values is compared, at said at least one base station, with a second predetermined value in step (c), and the power values exceeding said second predetermined value being used to determine said power control coefficient.
9. A method as claimed in claim 6, 7 or 8, further comprising the steps of:

receiving, at said at least one base station, total transmission power of each of said plurality of base stations from MTSO which is provided in said CDMA cellular system to supervise overall operations of the system;
determining, at said at least one base station, another power control coefficient which is a ratio of $(P_1Q_1 + P_2Q_2 + \dots + P_kQ_k)$ to $(G_h \cdot P_m \cdot B_0)$ where P_i ($i=1, 2, \dots, k$) is the total transmission power of an i -th base station, Q_i ($i=1, 2, \dots, k$) is the power value of the pilot signal of an i -th base station other than said at least one base station, P_m is a maximum transmission power of each of the base stations, and B_0 is the power value of pilot signal of said at least one base station; and
controlling the transmission power of said at least one base station using said another power control coefficient instead of the first-mentioned power control coefficient.

10. A method of controlling transmission power of at least one base station among a plurality of base stations associated with a mobile unit in a CDMA cellular system, said mobile unit communicating with said at least one base station, said method comprising the steps of:

(a) measuring, at said mobile unit, a first power value of a pilot signal transmitted from said at least one base station and a plurality of second power values each transmitted from said plurality of base stations other than said at least one base station;
(b) determining, at said mobile unit, a power control coefficient using said first and second power values;
(c) advising said at least one base station of said power control coefficient; and
(d) controlling the transmission power of said at least one base station using said power con-

trol coefficient.

11. A method as claimed in claim 10, wherein each of said first and second values is compared, at said mobile unit, with a predetermined value after step (a), a power value exceeding said predetermined value being selected, and the values of selected power being used to determine said power control coefficient in step (b).
12. A method as claimed in any one of claims 6 to 11, wherein said power control coefficient is a ratio of said first and second power values.

Patentansprüche

1. Verfahren zum Regeln der Sendeleistung mindestens einer Basisstation unter mehreren einer Mobileinheit zugeordneten Basisstationen in einem zellularen Codemultiplex-Vielfachzugriff (CDMA-) -System, wobei die Mobileinheit mit der mindestens einen Basisstation kommuniziert, mit den Schritten:

(a) Messen des Leistungswertes jedes von mehreren Pilotsignalen, die jeweils von den mehreren Basisstationen übertragen werden, an der Mobileinheit;
(b) Bestimmen eines ersten Leistungssteuerkoeffizienten, der ein Verhältnis der gesamten Pilotsignalleistungswerte der mehreren Basisstationen, die von der mindestens einen Basisstation verschieden sind, zu einem Pilotsignalleistungswert der mindestens einen Basisstation darstellt; und
(c) Steuern der Sendeleistung der mindestens einen Basisstation unter Verwendung des ersten Leistungssteuerkoeffizienten.

2. Verfahren nach Anspruch 1, wobei der Leistungswert jedes Pilotsignals an der Mobileinheit nach Schritt (a) mit einem vorgegebenen Wert verglichen wird, ein den vorgegebenen Wert überschreitender Leistungswert ausgewählt wird, und die ausgewählten Leistungswerte an die mindestens eine Basisstation übertragen und in Schritt (b) zum Bestimmen des ersten Leistungssteuerkoeffizienten verwendet werden, wobei der erste Leistungssteuerkoeffizient in Schritt (c) zum Steuern der Sendeleistung verwendet wird.

3. Verfahren nach Anspruch 1, wobei der Leistungswert jedes Pilotsignals an der Mobileinheit nach Schritt (a) mit einem ersten vorgegebenen Wert verglichen wird, ein den ersten vorgegebenen Wert überschreitender Leistungswert ausgewählt wird und die ausgewählten Leistungswerte an die mindestens eine Basisstation übertragen werden.

4. Verfahren nach Anspruch 3, wobei jeder der ausgewählten Leistungswerte an der mindestens einen Basisstation in Schritt (c) mit einem zweiten vorgegebenen Wert verglichen wird und wobei die den zweiten vorgegebenen Wert jeweils überschreitenden Leistungswerte zum Bestimmen des ersten Leistungssteuereffizienten verwendet werden.

5. Verfahren nach Anspruch 1, 2, 3 oder 4, ferner mit den Schritten:

Empfangen der im zellularen CDMA-System bereitgestellten Gesamtsendeleistung jeder der mehreren Basisstationen an der mindestens einen Basisstation von einer Mobilfunk-Vermittlungsstelle (MTSO), um die Gesamtoperation des Systems zu überwachen;
Bestimmen eines zweiten Sendeleistungssteuereffizienten an der mindestens einen Basisstation, der ein Verhältnis von $(P_1 Q_1 + P_2 Q_2 + \dots + P_k Q_k)$ zu $(G_h \cdot P_m \cdot B_0)$ ist, wobei P_i ($i = 1, 2, \dots, k$) die Gesamtsendeleistung einer i -ten Basisstation, Q_i ($i = 1, 2, \dots, k$) den Leistungswert des Pilotsignals einer von der mindestens einen Basisstation verschiedenen i -ten Basisstation, P_m eine maximale Sendeleistung jeder der Basisstationen und B_0 den Leistungswert des Pilotsignals der mindestens einen Basisstation bezeichnen; und
Steuern der Sendeleistung der mindestens einen Basisstation unter Verwendung des zweiten Leistungssteuereffizienten an Stelle des ersten Leistungssteuereffizienten.

6. Verfahren zum Steuern der Sendeleistung mindestens einer Basisstation unter mehreren einer Mobileinheit zugeordneten Basisstationen in einem zellularen Codemultiplex-Vielfachzugriff(CDMA-)System, wobei die Mobileinheit mit der mindestens einen Basisstation kommuniziert, mit den Schritten:

(a) Messen eines ersten Leistungswertes eines von der mindestens einen Basisstation übertragenen Pilotsignals und mehrerer zweiter Leistungswerte, die jeweils von den mehreren Basisstationen übertragen werden, die von der mindestens einen Basisstation verschieden sind, an der Mobileinheit;
(b) Informieren der mindestens einen Basisstation über den ersten Leistungswert und die zweiten Leistungswerte;
(c) Bestimmen eines Leistungssteuereffizienten unter Verwendung des ersten Leistungswertes und der zweiten Leistungswerte an der mindestens einen Basisstation; und
(d) Steuern der Sendeleistung der mindestens einen Basisstation unter Verwendung des Leistungssteuereffizienten.

7. Verfahren nach Anspruch 6, wobei der erste Leistungswert und die zweiten Leistungswerte an der Mobileinheit nach Schritt (a) mit einem ersten vorgegebenen Wert verglichen werden, und wobei der den ersten vorgegebenen Wert überschreitenden Leistungswert ausgewählt und an die mindestens eine Basisstation übertragen wird.

8. Verfahren nach Anspruch 6 oder 7, wobei der erste Leistungswert und die zweiten Leistungswerte an der mindestens einen Basisstation in Schritt (c) mit einem zweiten vorgegebenen Wert verglichen werden, und wobei die den zweiten vorgegebenen Wert überschreitenden Leistungswerte zum Bestimmen des Leistungssteuereffizienten verwendet werden.

9. Verfahren nach Anspruch 6, 7 oder 8, ferner mit den Schritten:

Empfangen der im zellularen CDMA-System bereitgestellten Gesamtsendeleistung jeder der mehreren Basisstationen von der Mobilfunk-Vermittlungsstelle (MTSO) an der mindestens einen Basisstation, um die Gesamtoperation des Systems zu überwachen;
Bestimmen eines anderen Leistungssteuereffizienten an der mindestens einen Basisstation, der ein Verhältnis von $(P_1 Q_1 + P_2 Q_2 + \dots + P_k Q_k)$ zu $(G_h \cdot P_m \cdot B_0)$ ist, wobei P_i ($i = 1, 2, \dots, k$) die Gesamtsendeleistung einer i -ten Basisstation, Q_i ($i = 1, 2, \dots, k$) den Leistungswert des Pilotsignals einer von der mindestens einen Basisstation verschiedenen i -ten Basisstation, P_m eine maximale Sendeleistung jeder der Basisstationen und B_0 den Leistungswert des Pilotsignals der mindestens einen Basisstation bezeichnen; und
Steuern der Sendeleistung der mindestens einen Basisstation unter Verwendung des anderen Leistungssteuereffizienten an Stelle des zuerst erwähnten Leistungssteuereffizienten.

10. Verfahren zum Steuern der Sendeleistung mindestens einer Basisstation unter mehreren einer Mobileinheit zugeordneten Basisstationen in einem zellularen Codemultiplex-Vielfachzugriff(CDMA-)System, wobei die Mobileinheit mit der mindestens einen Basisstation kommuniziert, mit den Schritten:

(a) Messen eines ersten Leistungswertes eines von der mindestens einen Basisstation übertragenen Pilotsignals und mehrerer zweiter Leistungswerte, die von den mehreren Basisstationen übertragen werden, die von der mindestens einen Basisstation verschieden sind, an der Mobileinheit;

- (b) Bestimmen eines Leistungssteuereffizienten unter Verwendung des ersten Leistungswertes und der zweiten Leistungswerte an der Mobileinheit;
 (c) Informieren der mindestens einen Basisstation über den Leistungssteuereffizienten;
 und
 (d) Steuern der Sendeleistung der mindestens einen Basisstation unter Verwendung des Leistungssteuereffizienten.
- 5
- 10
- 15
- 20
- 25
11. Verfahren nach Anspruch 10, wobei der erste Leistungswert und die zweiten Leistungswerte an der Mobileinheit nach Schritt (a) mit einem vorgegebenen Wert verglichen werden und wobei die den vorgegebenen Wert überschreitenden Leistungswerte ausgewählt und in Schritt (b) zum Bestimmen des Leistungssteuereffizienten verwendet werden.
12. Verfahren nach einem der Ansprüche 6 bis 11 wobei der Leistungssteuereffizient ein Verhältnis zwischen dem ersten Leistungswert und den zweiten Leistungswerten ist.

Revendications

1. Procédé de commande de la puissance de transmission d'au moins une station de base parmi une pluralité de stations de base associées à une unité mobile dans un système cellulaire AMDC (accès multiple par différence de code), ladite unité mobile communiquant avec ladite au moins une station de base, ledit procédé comprenant les étapes:
- 30
- 35
- 40
- 45
- 50
- 55
- (a) mesurer, au niveau de ladite unité mobile, une valeur de puissance de chaque signal pilote d'une pluralité de signaux pilotes respectivement transmis par ladite pluralité de stations de base ;
 (b) déterminer un premier coefficient de commande de puissance qui est un rapport de valeurs totales de puissance de signal pilote de ladite pluralité de stations de base, autres que ladite au moins une station de base, sur une valeur de puissance de signal pilote de ladite au moins une station de base ; et
 (c) commander la puissance de transmission de ladite au moins une station de base en utilisant ledit premier coefficient de commande de puissance.
2. Procédé selon la revendication 1, dans lequel la valeur de puissance de chacun des signaux pilotes est comparée, au niveau de ladite unité mobile, avec une valeur prédéterminée après l'étape (a), une puissance dépassant la valeur prédéterminée étant sélectionnée, et les valeurs de la puissance
- sélectionnée étant envoyées à ladite au moins une station de base et utilisées pour déterminer ledit premier coefficient de commande de puissance à l'étape (b), ledit premier coefficient de commande de puissance étant utilisé pour commander la puissance de transmission à l'étape (c)
3. Procédé selon la revendication 1, dans lequel la valeur de puissance de chacun des signaux pilotes est comparée, au niveau de ladite unité mobile, avec une première valeur prédéterminée après l'étape (a), une puissance dépassant la première valeur prédéterminée étant sélectionnée, et les valeurs de la puissance sélectionnée étant envoyées à ladite au moins une station de base.
4. Procédé selon la revendication 3, dans lequel chacune des valeurs de la puissance sélectionnée est comparée, au niveau de ladite au moins une station de base, avec une deuxième valeur prédéterminée à l'étape (c), et les valeurs de puissance dépassant ladite deuxième valeur prédéterminée étant utilisées pour déterminer ledit premier coefficient de commande de puissance.
5. Procédé selon la revendication 1, 2, 3 ou 4, comprenant en outre les étapes:
- recevoir, au niveau de ladite au moins une station de base, la puissance de transmission totale de chaque station de base de ladite pluralité de stations de base provenant d'un centre de commutation pour téléphonie mobile (MT-SO), qui se situe dans ledit système cellulaire AMDC pour superviser l'ensemble des opérations du système ;
 déterminer, au niveau de ladite au moins une station de base, un deuxième coefficient de commande de puissance qui est un rapport de $(P_1 Q_1 + P_2 Q_2 + \dots + P_k Q_k)$ sur $(G_h \cdot P_m \cdot B_0)$ où P_i ($i = 1, 2, \dots, k$) est la puissance de transmission totale d'une $i^{\text{ème}}$ station de base, Q_i ($i = 1, 2, \dots, k$) est la valeur de puissance du signal pilote d'une $i^{\text{ème}}$ station de base autre que ladite au moins une station de base, P_m est une puissance de transmission maximale de chacune des stations de base, et B_0 est la valeur de puissance du signal pilote de ladite au moins une station de base ; et
 commander la puissance de transmission de ladite au moins une station de base en utilisant ledit deuxième coefficient de commande de puissance à la place dudit premier coefficient de commande de puissance.
6. Procédé de commande de puissance de transmission d'au moins une station de base d'une pluralité de stations de base associées à une unité mobile

dans un système cellule AMDC, ladite unité mobile communiquant avec ladite au moins une station de base, ledit procédé comprenant les étapes:

- (a) mesurer, au niveau de ladite unité mobile, une première valeur de puissance d'un signal pilote transmis par ladite au moins une station de base et une pluralité de deuxième valeurs de puissance transmises chacune par ladite pluralité de stations de base autres que ladite au moins une station de base ;
 - (b) aviser ladite au moins une station de base desdites premières et deuxième valeurs de puissance ;
 - (c) déterminer, au niveau de ladite au moins une station de base, un coefficient de commande de puissance en utilisant ladites premières et deuxième valeurs de puissance ; et
 - (d) commander la puissance de transmission de ladite au moins une station de base en utilisant ledit coefficient de commande de puissance.
7. Procédé selon la revendication 6, dans lequel chacune desdites premières et deuxième valeurs est comparée, au niveau de ladite unité mobile, avec une première valeur prédéterminée après l'étape (a), la valeur de puissance dépassant ladite première valeur prédéterminée étant sélectionnée et envoyée à ladite au moins une station de base.
8. Procédé selon la revendication 6 ou 7, dans lequel chacune desdites premières et deuxième valeurs est comparée, au niveau de ladite au moins une station de base, avec une deuxième valeur prédéterminée à l'étape (c), et les valeurs de puissance dépassant ladite deuxième valeur prédéterminée étant utilisées pour déterminer ledit coefficient de commande de puissance.
9. Procédé selon la revendication 6, 7 ou 8, comprenant en outre les étapes:
- recevoir, au niveau de ladite au moins une station de base, la puissance de transmission totale de chaque station de base de ladite pluralité de stations de base provenant d'un MTSO, qui se situe dans ledit système cellulaire AMDC pour superviser l'ensemble des opérations du système ;
- déterminer, au niveau de ladite au moins une station de base, un autre coefficient de commande de puissance qui est un rapport de $(P_1 Q_1 + P_2 Q_2 + \dots + P_k Q_k)$ sur $(G_h \cdot P_m \cdot B_0)$ où P_i ($i = 1, 2, \dots, k$) est la puissance de liaison totale d'une $i^{\text{ème}}$ station de base, Q_i ($i = 1, 2, \dots, k$) est la valeur de puissance du signal pilote d'une $i^{\text{ème}}$ station de base autre que ladite au

moins une station de base, P_m est une puissance de transmission maximale de chacune des stations de base, et B_0 est la valeur de puissance du signal pilote de ladite au moins une station de base ; et

commander la puissance de transmission de ladite au moins une station de base en utilisant ledit autre coefficient de commande de puissance à la place dudit coefficient de commande de puissance cité en premier.

10. Procédé de commande de puissance de transmission d'au moins une station de base d'une pluralité de stations de base associées à une unité mobile dans un système cellule AMDC, ladite unité mobile communiquant avec ladite au moins une station de base, ledit procédé comprenant les étapes:

(a) mesurer, au niveau de ladite unité mobile, une première valeur de puissance d'un signal pilote transmis par ladite au moins une station de base et une pluralité de deuxième valeurs de puissance transmises chacune par ladite pluralité de stations de base autres que ladite au moins une station de base ;

(b) déterminer, au niveau de ladite unité mobile, un coefficient de commande de puissance en utilisant ladites premières et deuxième valeurs de puissance ;

(c) aviser ladite au moins une station de base dudit coefficient de commande de puissance ; et

(d) commander la puissance de transmission de ladite au moins une station de base en utilisant ledit coefficient de commande de puissance.

11. Procédé selon la revendication 10, dans lequel chacune desdites premières et deuxième valeurs est comparée, au niveau de ladite unité mobile, avec une valeur prédéterminée après l'étape (a), une valeur de puissance dépassant ladite valeur prédéterminée étant sélectionnée, et les valeurs de la puissance sélectionnée étant utilisées pour déterminer ledit coefficient de commande de puissance à l'étape (b).

12. Procédé selon l'une quelconque des revendications 6 à 11, dans lequel ledit coefficient de commande de puissance est un rapport desdites premières et deuxième valeurs de puissance.

FIG. 1

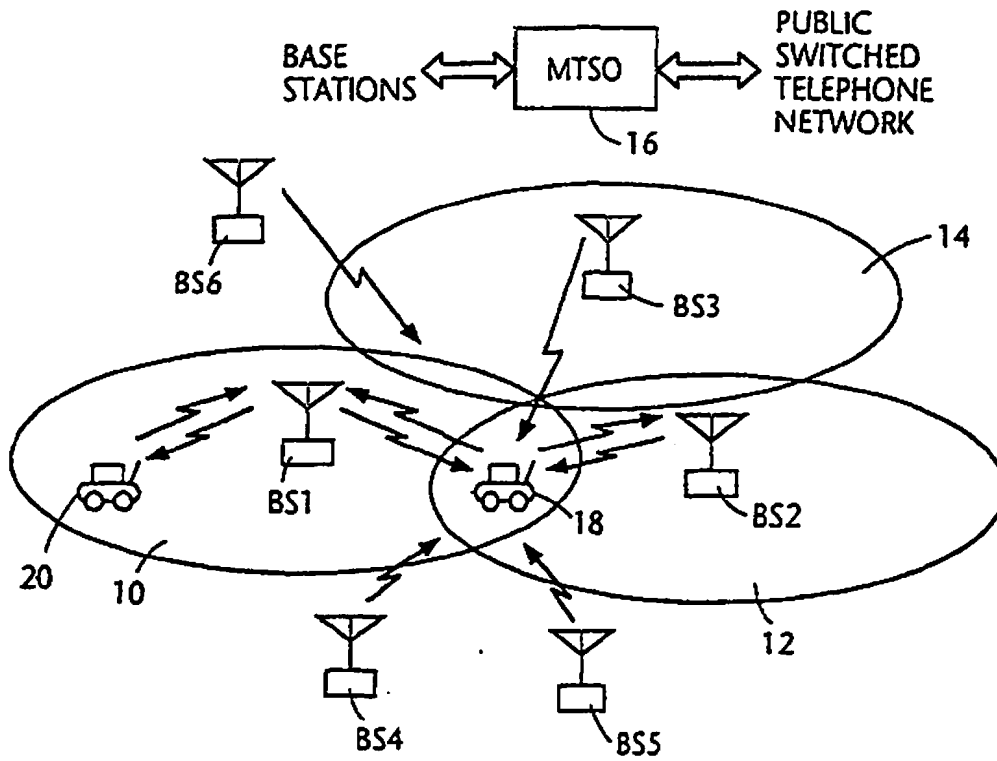


FIG. 2

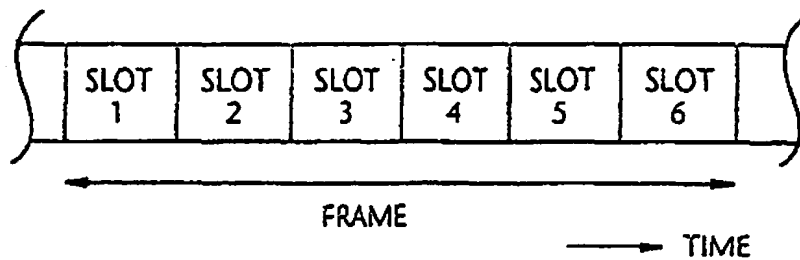


FIG. 3

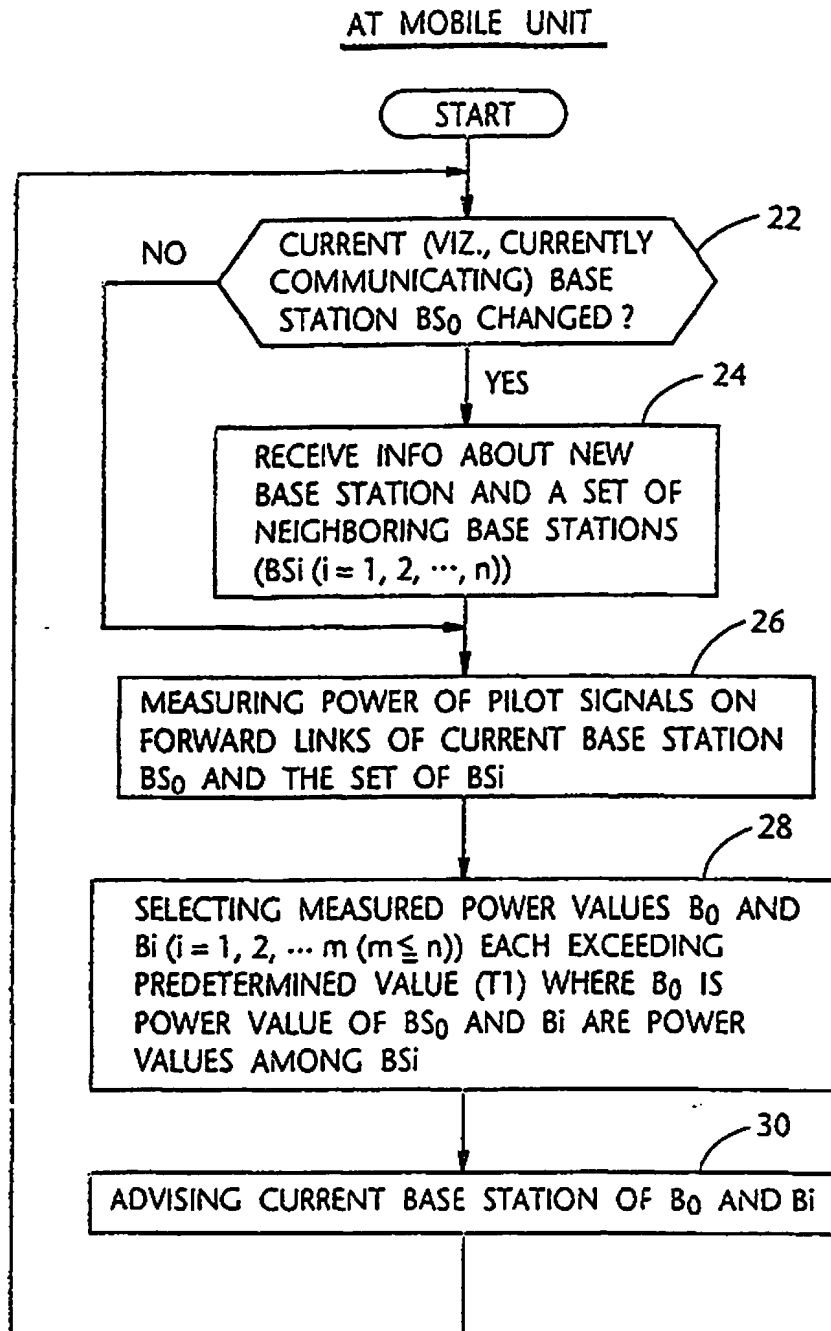


FIG. 4A

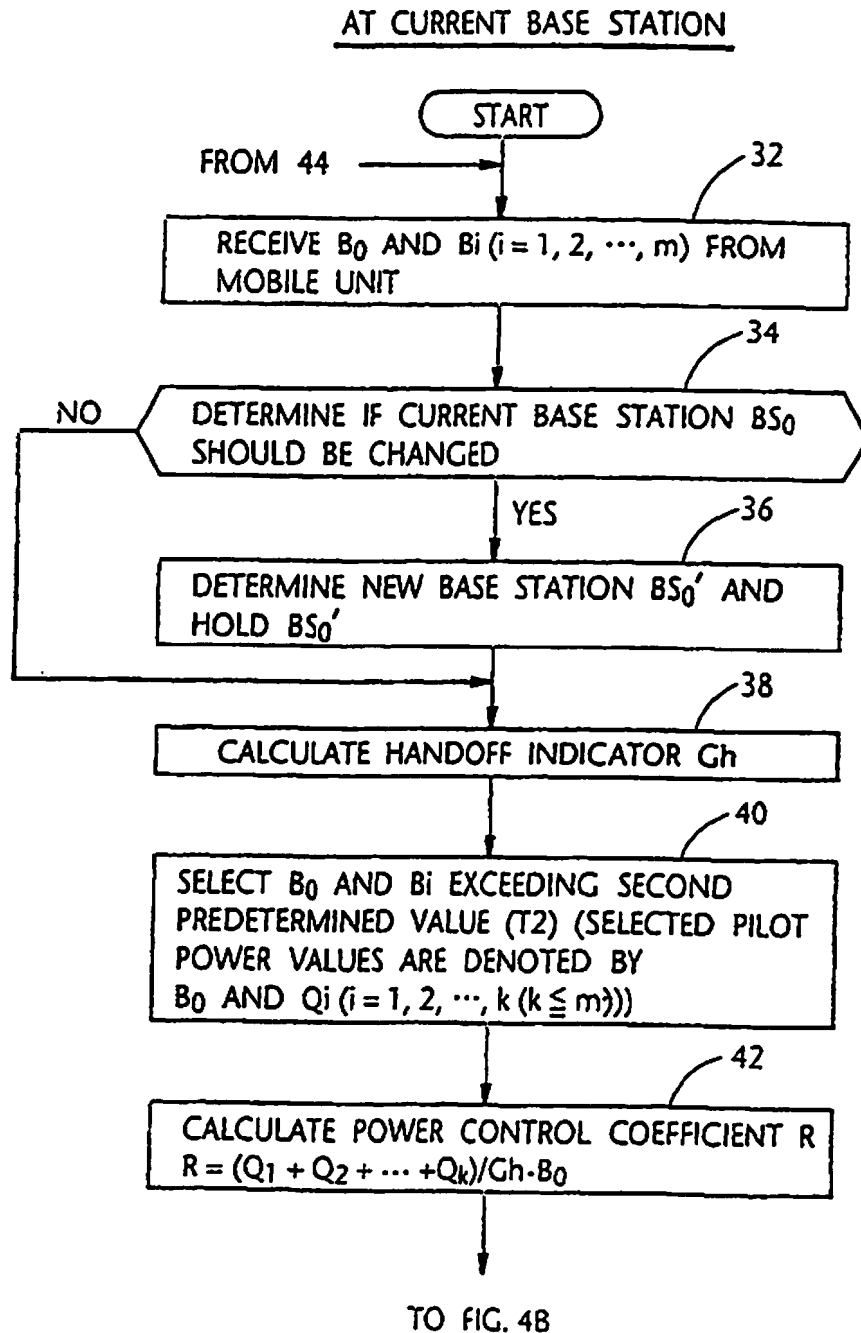


FIG. 4B

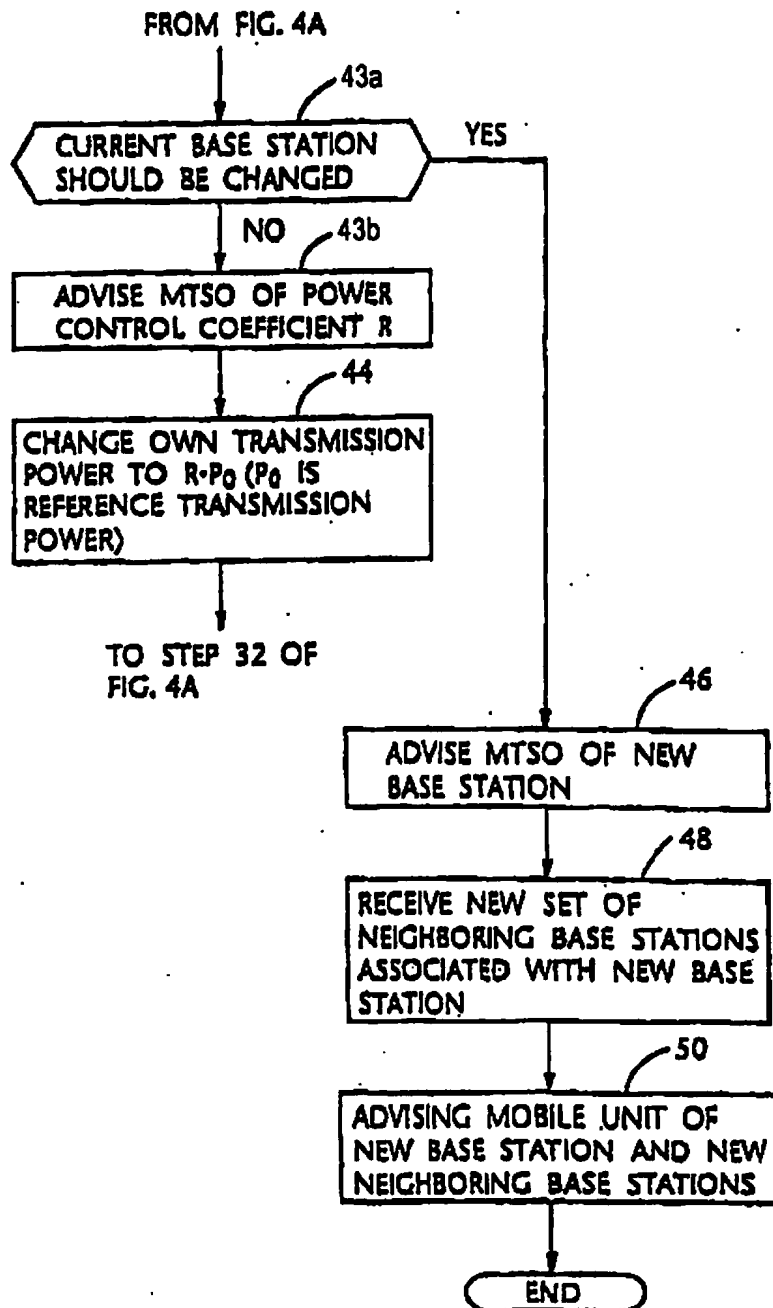


FIG. 5A

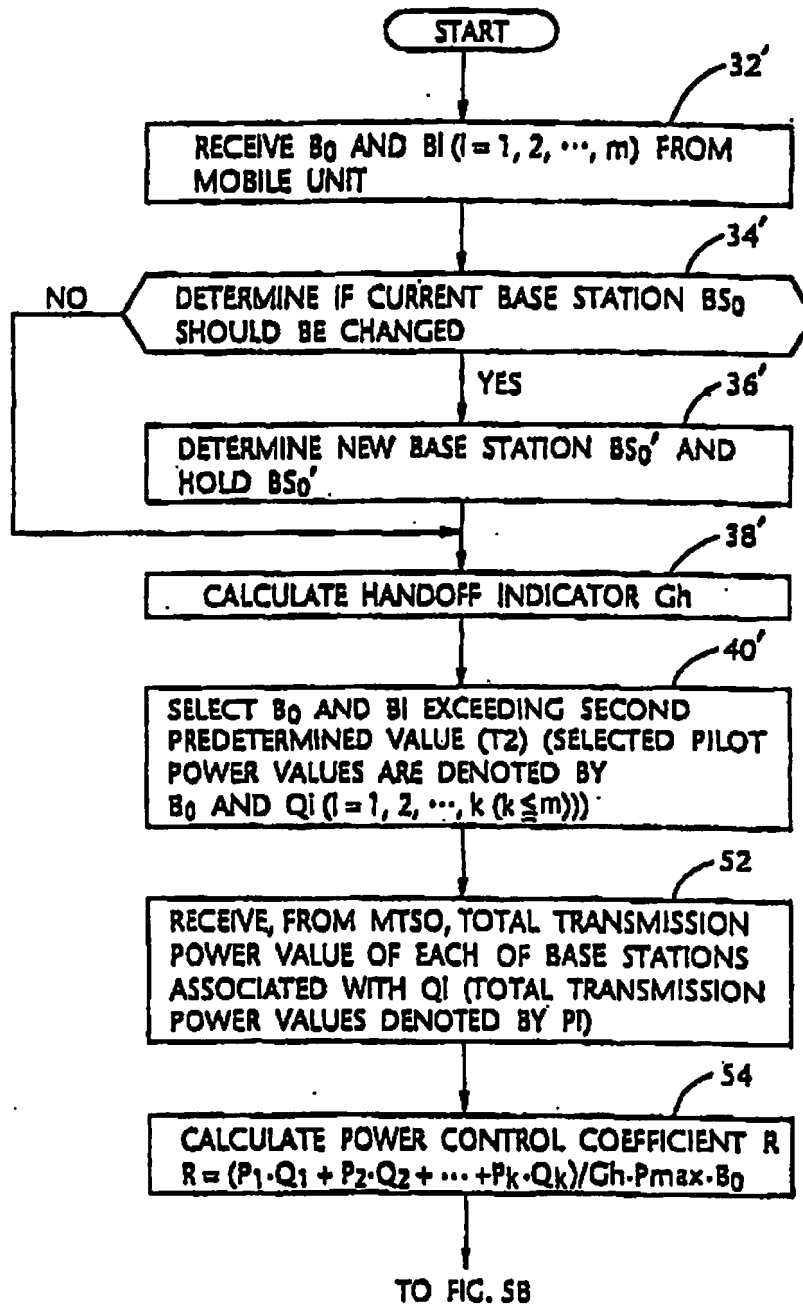
AT CURRENT BASE STATION

FIG. 5B

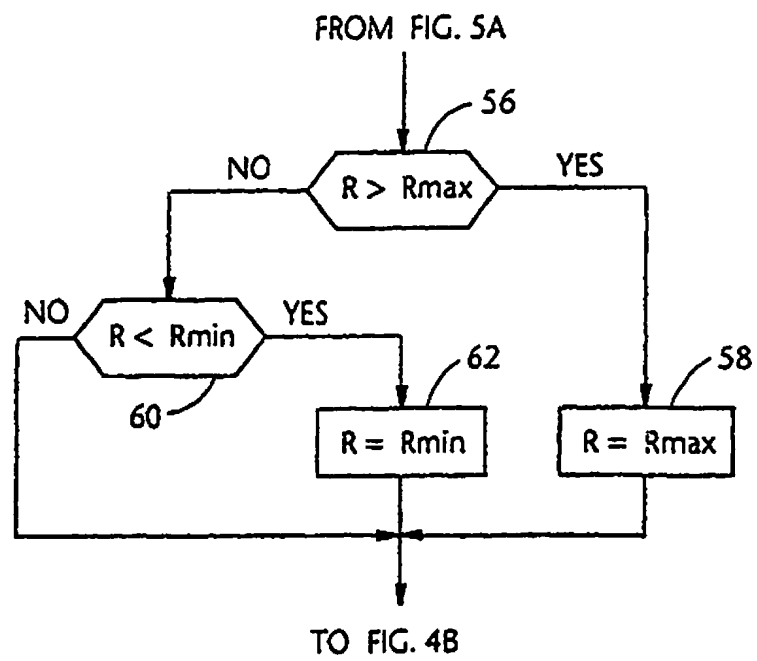


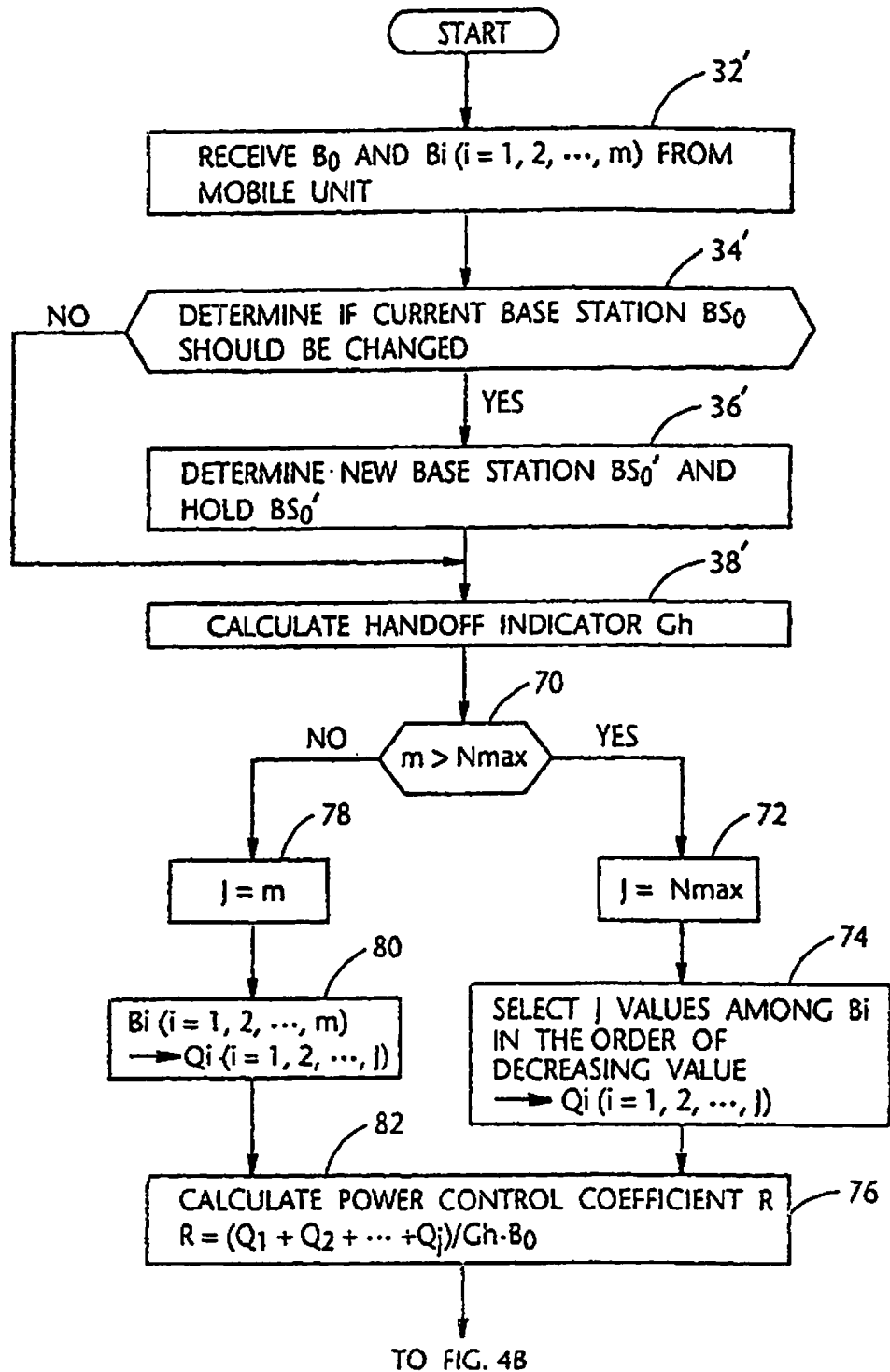
FIG. 6AT CURRENT BASE STATION

FIG. 7A

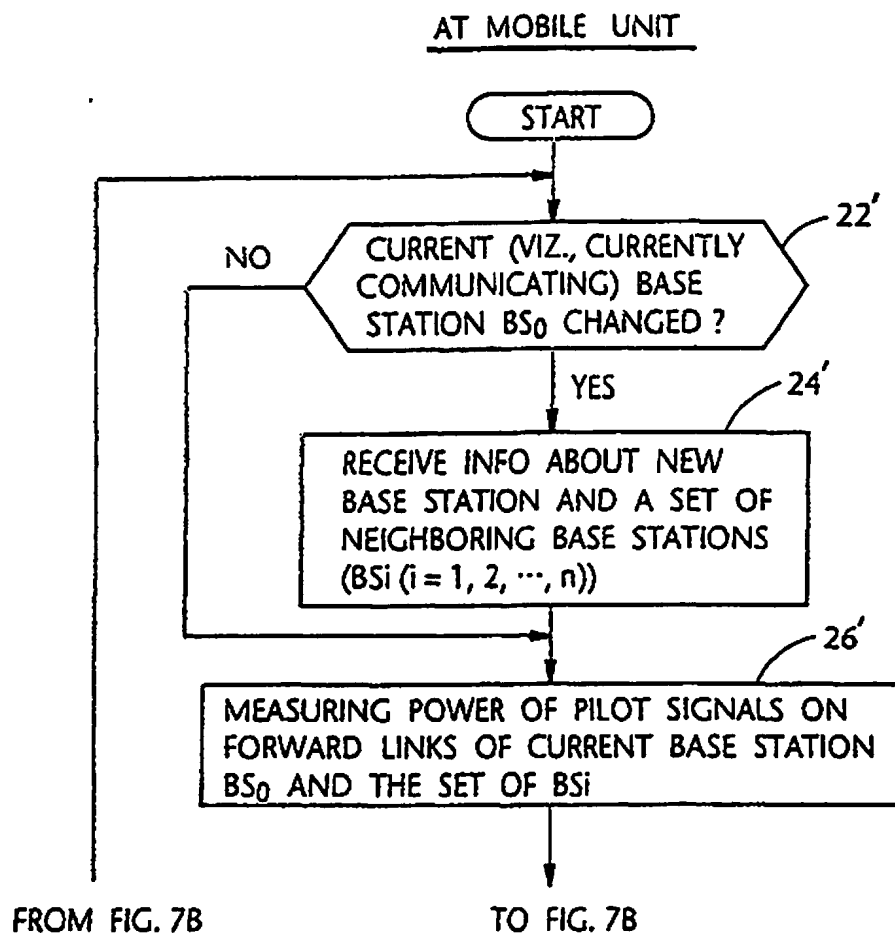


FIG. 7B

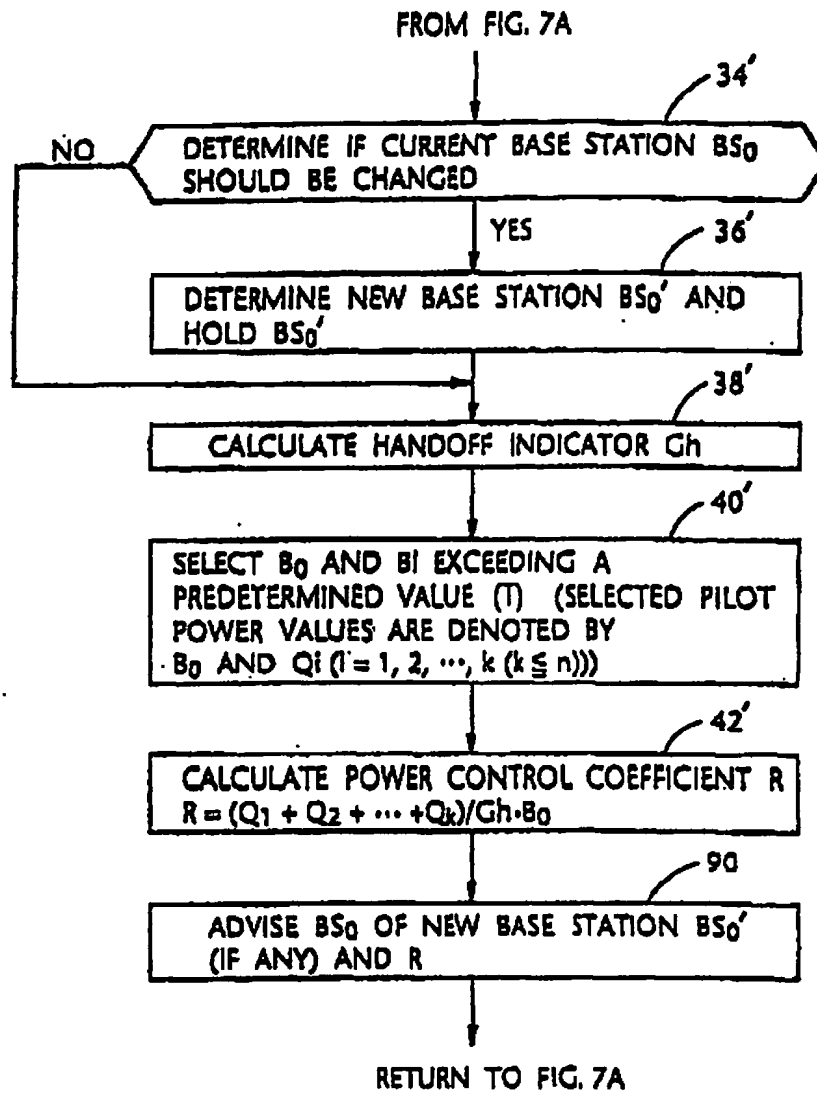


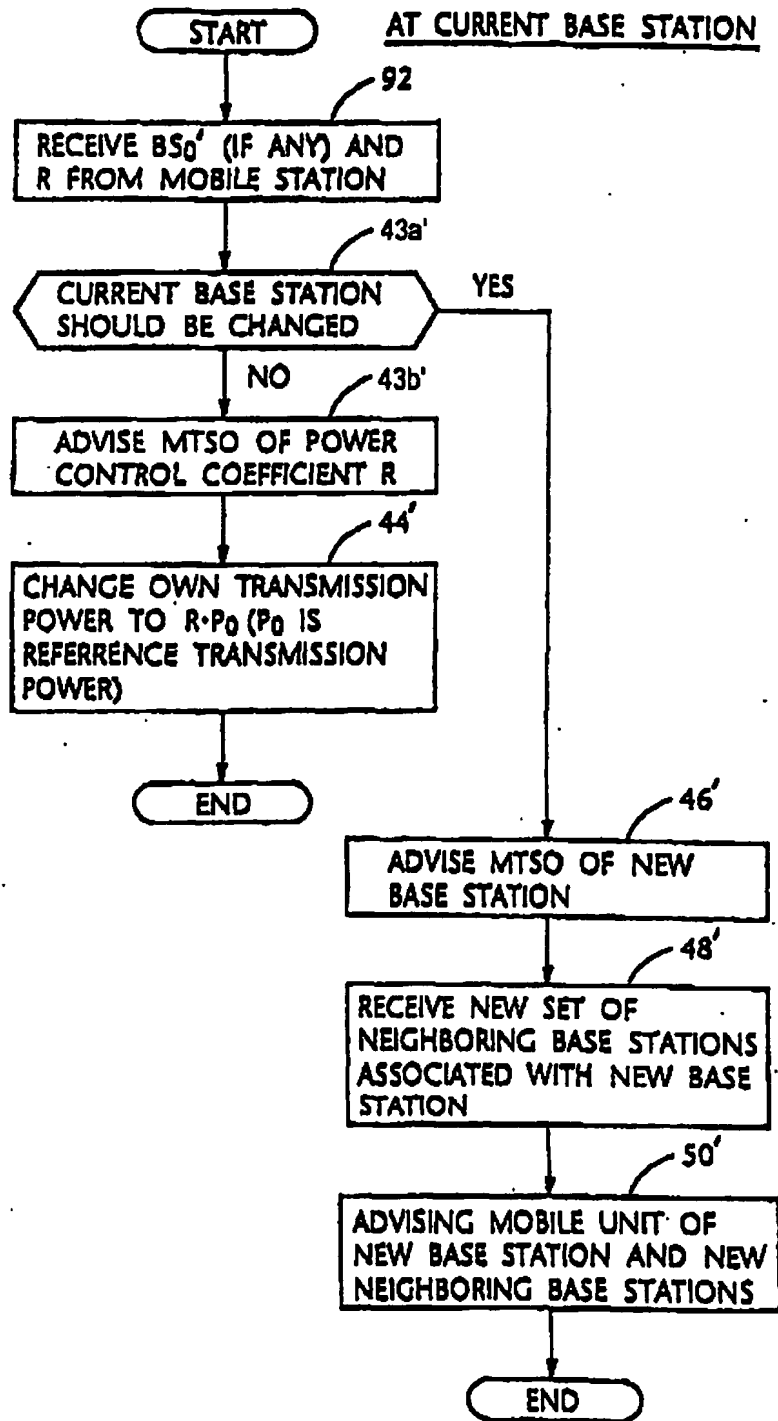
FIG. 8

FIG. 9A

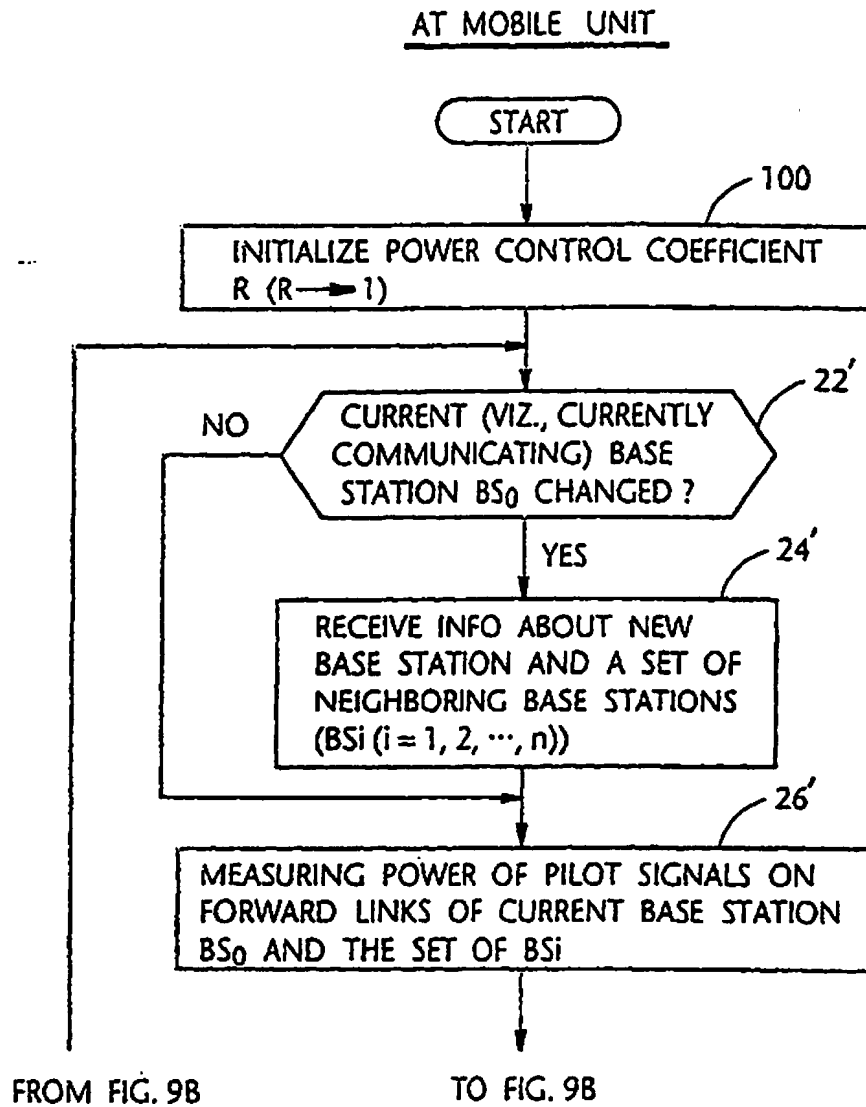


FIG. 9B

FROM FIG. 9A

